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PARASITES AND HABITS OF *DIANTHIDIUM PUDICUM* CRESSON

CHARLES H. HICKS,
University of Colorado.

The habits of *Dianthidium pudicum* Cresson[1] have not previously been known, as far as it can be learned from a review of the literature. The following account is based on studies of the species, at or near Boulder, Colorado.

D. pudicum builds cells of pebbles and resin, placing them in depressions or attaching them to the sides of rocks, in fields and open places. Nests of this bee were first taken in the fall of 1925. Many have since been found at all seasons and, during the summer of 1926, observations were made on the constructing and provisioning of a nest.

Cells have been taken from the stones, brought to the laboratory where they were kept at room temperature, and the insects reared. In this way a number of bees and several parasites have been obtained.

From a nest secured April 11, 1926 at East Boulder, a male and female parasitic wasp, *Eusapyga proxima* Cresson[2], emerged on May 12, 1926; a female wasp May 14; a male *D. pudicum* May 18; and a male wasp on May 21. Specimens of *E. proxima* have emerged from some other nests of *D. pudicum* and always from the cocoon of the latter insect. This fact shows that the parasite lives on the tissues of the young bee larva or pupa and does not early crowd it out, using its food, as do certain bees living in the cells of other bees (e. g. *Stelis sexmaculata* on *Alcidamea producta*)[3].

[1]Kindly determined by Professor T. D. A. Cockerell.
[2]This wasp has been determined by Mr. S. A. Rohwer.
[3]Reported by Graenicher, 1905.

Nests of *D. pudicum*, although not very rare, are rather difficult to find, because of the fact that they often closely resemble in color the rock to which they are attached. Again, they may fill in a depression, giving the rock a smooth outline and therefore easily overlooked. Many fields, in which these bees nest, are nearly covered with rocks and the task of finding the ones used is great. However, a bee sometimes selects a very light or white rock and builds upon it a nest consisting of dark pebbles.

When the weather is dry, the pebbles and resin become very hard and the nest is difficult to remove. Rain or very moist weather softens the material and may aid in making it easier for the mature insect to emerge.

The number of cells to a nest have varied from 2 to 8. A cocoon, which appeared to be of average size, measured 9 mm. in length from the tip of the mammillary projection to the base of the cocoon. The width at the center was a little over 4 mm. The base is slightly curved; the apex flat except for a short, blunt mammillary point. This point was much lighter than the dark, yellowish brown cocoon.

Observations were made on the habits of a bee of this species found nesting on a rock at Owens' Lake, late in the afternoon of August 24, 1926. When located one cell had already been constructed, with the orifice down. This opening was clear cut, or sharply and very neatly outlined. At 6 p. m. the female was resting within, where she spent the night, with the posterior part of her body towards the outside. Some data were obtained on following days, part of which are given below.

August 25. By 11 a. m. the orifice of the first cell was closed and a second had been started. The bee was now carrying resin and pebbles to the nest. Later, when she was walking over it slowly, as though inspecting it, a male came and mated with her on the finished cell. The period of copulation was of about 30 seconds duration.

August 27. The bee was observed flying about in the morning, probably gathering honey.

August 31. To-day, the fourth cell has been made. The place and order of occurrence had been noted on previous days.

Three of the four cells were finished. The second was to the right of the first; the third to the left of the first; and the fourth above and over the first, being attached to the rock above and partially covering the finished cell. At 9:46 a. m. the bee returned pollen laden, from a collecting trip. She entered the cell head first, and stayed within 20 seconds. She then came out, backed in to deposit the pollen and remained 35 seconds. Later in the day, when she was collecting resin, it was observed that she averaged 7 minutes in securing a load. She carried the lump of light colored resin in her mandibles and deposited it in the anterior part of the unfinished cell.

September 2. At 3 p. m. a fifth cell had been made. The sky being overcast, the bee was inside resting. The cell was above the second and parallel to the fourth. The opening was down, as has been found true of all others observed in the process of construction. Later in the afternoon, the bee was seen to be smoothing the inside of the cell with her mandibles.

September 4. To-day, a sixth cell was partly finished and the bee was seen for the last time and no further work was done. The nest was taken home September 26.

Notes on Construction of Cell.

Considerable time was spent in observing the bee constructing the cells. The resin, which had been placed in the anterior part of the cell after each collecting trip, was used as needed. The bee would take some of the resin and place it on the edge of the cell, often between two pebbles. Then she would fly to the ground and select a pebble, sometimes from very near and again as far as six feet away. The pebble was carried in her mandibles to the nest, where the legs and thorax were used to fit it into place. It is worthy of note that the bee endeavoured to place the pebble where she had previously put the resin. If the pebble did not hold, as was sometimes the case, she would get some more resin and place it usually on the same spot.

The pebble dropped was never immediately utilized again, but a new one selected. However, since she often gathered those near, she sometimes later used the ones previously tried.

In placing a pebble in a crevice or on a resin extension, the pebble was turned and rearranged, by means of the legs and abdomen, much as a mason fits a stone into place. The pebble remaining, the bee placed resin on its free edges and another was brought. Sometimes when a pebble did not fit into place, the bee tried it all about the edge of the cell in an attempt to get it to hold.

After a few trips to the cell under construction, the bee was seen to carry a pebble and place or fit it onto the general surface of the outside of the other cells, mainly in the depressions between them. This helped to break the outlines of the individual cells and make the surface more even, as well as make the walls thicker and the protection greater. Another nest of this bee, also found at Owens' Lake during this period, showed considerable thickness of resin and pebbles placed after the cells had been made. Old nests, from which bees have emerged, often show little or no trace of individual cells, probably due to the heat making the resin soft and allowing the material gradually to settle.

The contents of the cells, of the nest observed, were examined on September 26, with the following facts noted. A cocoon was found each in cells 1 and 3; but larvæ in 4 and 5. Number 2 contained much pollen and a small dead larva. The lower end of the first cell had been closed with a layer of pebbles and resin about one millimeter thick The upper end of the inner space of the cell was filled with a cocoon, surrounded with pellets of excrement; the lower part contained a space partly filled with excrement. The cocoon possessed a very distinct mammillary projection which extended downward. The head of the larva has always been towards this point.

The length of a typical cell has been found to be 15 mm. At the end opposite the location of the orifice the mass of pollen, filling the cell for a distance of 5 mm., is stored. The remaining 10 mm. of space is at first empty; later, when the larva has developed, part of the space is filled with the cocoon and part with excrement.

On October 3, the larva of cell number 4 had a fully formed cocoon which had been started October 1. The mammillary point first consisted of a round hole, with a white outer surface

of silk. The larva of number 5 started a cocoon on October 6. It was at first very thin and white and early had a mammillery point apparently closed. The following day the cocoon was more compact and darker. A few days later it had quite its normal color.

On January 31, 1926 a nest, agreeing in all points of construction with nests of *D. pudicum,* was found attached to a rock along the railroad of East Boulder. Four female and one male *Monodontomerus montivagus* Ashmead emerged from a typical Dianthidium cocoon on February 20. A single hole was chewed through the side of the cocoon, all emerging through this opening. The male was observed to mate with two females. When he first alighted on the female, she vibrated her antennæ very rapidly, after which she remained nearly motionless. The male, well forward on the female, continued a rather periodic raising and lowering of his antennæ, moving first the one and then the other. Frequently he would raise his wings, vibrate them rapidly for a second, then lower them until the performance was repeated again in about 20 seconds. After 3 minutes the male moved back and copulation was effected, lasting but a second.

From another cocoon a wasp, *Odynerus* (*Stenodynerus*) n. sp.[4] which appears to be parasitic on *D. pudicum,* emerged on March 5. No other insects emerged and on May 5 the remaining two cocoons were opened. Each contained a wasp, nearly mature, but dead. These wasps were not easily determined but appeared to be young of *E. proxima.* The nest had been used a number of times as was evidenced by the fact that used cocoons were found, one within another, to the number of seven. While no bees were reared from the nest, the cocoons, type of nest, etc., were so typically those of *D. pudicum* that it has seemed safe to consider it as such.

A nest, also agreeing with the nests of *D. pudicum* taken here, was found in the summer of 1926 by Mrs. Hicks at Uva, some 6 miles north of Wheatland, Wyoming. One of the cocoons of this nest contained dead, but nearly mature parasites, *M. montivagus.*

[4]Kindly determined by Mr. S. A. Rohwer. More evidence should be obtained before definitely ascribing this wasp a parasite of *D. pudicum.*

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NESTING HABITS OF A SOLITARY BEE OF THE GENUS *SPINOLIELLA* OF ASHMEAD[1]

By Clarence P. Custer,
University of Colorado, Boulder, Colo.

The nests of the bees of this genus are generally hard to find. The insects are so small, usually not more than a quarter inch long, that they are difficult to follow in their flight. In fact, so far as I can tell, no information is available on their nesting habits.

It was on a fine sunny day in the latter part of August, 1927, while visiting the Country Club at Denver, Colorado, that my attention was called to some small mounds of dark soil resembling ant nests. These were located along the side of a tennis court. It was soon evident that they were the nests of some bees. They had picked three different areas in which to establish their dwellings. Each colony possessed some forty or fifty nests separated from one another by a distance of about six inches.

Each day the courts had been moistened and rolled by the caretaker. And each day the busy owners had thrown up the small mounds of soil over their entrances. When I arrived, the colonies were bustling with work. Here was a bee opening the entrance to her nest. Up the tunnel she backed, pushing a load of earth. When almost to the top, she suddenly stopped and descended for another load. The earth in the entrance-way remained without falling. Presently she was up again with some more. This was also pushed out of the entrance a portion remaining in the passage-way as before. The little mound of soil above the nest was steadily increasing in size. Over here was a female just in from the fields. Her hind legs were heavy and quite conspicuous with their loads of green pollen. Back and forth she circled, undecided which of the nests was her own. Several times she alighted on the ground. After a minute, the problem solved, she hovered over her nest and entered. In other

[1] *Spinoliella australior* Ckll. Determined by Miss Grace Sandhouse.

places, other females were coming in from the fields. Some had loads of green pollen; others had yellowish-green. Could they be visiting different species of flowers?[2] All the while, in a constant whir of motion, the males of the colony were circling above the nests. Occasionally one alighted for a moment or two but was soon on his way. The male was not to be worried with the intricate problems of nesting. His was a life of pleasure.

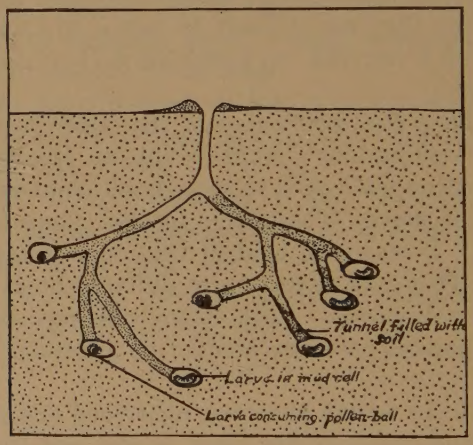

Fig. 1. Plan of nest of *Spinoliella australior*. The nests, which extend down to a depth of three or four inches, contain about seven larvæ. This is a vertical section of the earth showing all the ramifications of the nest. Coarse stippling indicates cut surface of earth; light stippling, loose soil. (One half natural size).

Upon digging up the nests of these bees, I was surprised to find that they extended no deeper than three or four inches. Most of the tunnels led straight down for an inch and then branched. So far as the galleries were open, it was clear which way they went. But when I reached the depth where they had been filled with soil, the passage-way was usually invisible. It blended perfectly with the surrounding clay. However, in a few instances, I was able to trace the galleries down to the cells. The general plan of these nests is shown in Fig. 1. The main tunnel usually branched once, and then the two passage-ways

[2]Miss Sandhouse informs me that *Spinoliella australior* visits the flowers of the following plants: *Dithyrea wislizeni*, *Cleome serrulata* and *Solidago canadensis*. The pollen of *Cleome serrulata* is somewhat green.

resulting from this gave off three or four short galleries each of which ended at a cell. Hence there were approximately six cells to each nest. If it is to be assumed that each female is capable of laying fifteen eggs, then more than one nest must have been provisioned by each bee. She probably finished one nest and then constructed another. Surely a female was not taking care of two nests simultaneously as has been observed in the case of *Dianthidium sayi* Ckll. The reason for the latter assumption lies in the fact that in one colony of *Spinoliella*, consisting of about forty nests, I collected thirty-seven females. Then, when it was visited a few days later, there were just four nests being provisioned by as many bees. This is conclusive evidence that there was but one bee to a nest and *visa versa*.

As in the case of *Perdita opuntiæ* Ckll.[3] the pollen is constructed into a sphere and one end of the egg is inserted into this.[4] Furthermore, the cells for the larvæ have their walls similarly smoothed as though the insect had lapped them with its tongue. And, finally, it is interesting to note that the larvæ of these two bees are almost identical. Each has the typical double row of spines down its back. Some of the larvæ of *S. australior* are just as white as are those of *Perdita opuntiæ*; others however, which have probably consumed an over-abundance of pollen, are somewhat yellow.

In the key by T. D. A. Cockerell and W. W. Robbins ('10) the bees of these two genera differ principally from one another in the length of the marginal cell. In *Perdita* it is short and broadly truncate; in *Spinoliella* it is narrow and long.

It is hoped that further comparative work can be done on the nesting habits of *Perdita* and *Spinoliella* which resemble one another in so many respects.

[3]See Custer ('28).

[4]Malyshev ('25), in Russia, states that the larvæ of *Systropha planides* so start eating the pollen ball that it lies on their ventral surface, on top of them, thus preventing it from drying out from coming in contact with the cell wall. In the nest shown in Fig. 1 above, I found a larva in a similar position. This larva is pictured directly beneath the entrance.

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BEES OF THE GENUS HALICTUS FROM MIAMI, FLORIDA

By S. Graenicher,
South Miami, Fla.

The following two species belong to the group of Chloralictus with punctured tegulæ.

H. (Chloralictus) marinus Crawford.

Described from the female (**1**,99). The punctured tegulæ, which are pointed posteriorly, place it next to *tegulariformis* Crawford (New Mexico) in the Sandhouse key to females (**3**,1), but in the latter species the disk of the propodeum is granular while in marinus it has longitudinal rugæ running the length of the disk.

Male. Entire face up to the median ocellus covered with a dense short white pubescence. Head behind the eyes, sides of meso— and metathorax, scutellum, femora and sides of abdomen with long white hairs. Mesonotum and abdominal segments one to four above, shining and nearly bare. Facial quadrangle much narrower and longer than in the female. Clypeus produced half its length beyond the eyes. Antennæ dark above, light ferruginous underneath from second joint on. Tegulæ bare, shining, the punctures more plainly visible than in the female, Abdomen slender, with hardly a trace of testaceous coloration along the apical margins of the segments. Knees and tips of tibiæ narrowly testaceous, tarsi nearly white.

This species occurs at Miami Beach (across Biscayne Bay from Miami), where I have collected both males and females in January, July, August and December, at the flowers of the sunflower *Helianthus debilis*.[1] Quite recently (April 23, 1927) five males were found at Golden Beach (on the Atlantic Ocean north of Miami), visiting the flowers of *Alternanthera floridana*; also, one male and two females (April 29) on the sand dunes along the

[1]Nomenclature according to Small's "Flora of Miami" and the same author's "Flora of the Southeastern United States."

Atlantic Ocean north of Cape Florida (on Biscayne Key, across the Bay southeast of Miami). These, too, were taken on the flowers of *Alternanthera floridana*. In all three localities they were encountered on the upper beach, a short distance from the ocean, and this agrees entirely with what Viereck and Crawford observed in New Jersey and Virginia. According to the former's statement (cited by Crawford, **1**), the specimens were swept at Ocean City, N. J. (type locality) from plants "growing along the strand just within the beach, and constituting the first zone of plant life from the ocean." Crawford (**2**,580) came across this species at Virginia Beach, Va. "on grasses on the beach just above high tide limit." In view of these facts it is safe to assume that *H. marinus* is an inhabitant of the upper sandy beaches along the entire Atlantic coast from south Florida to New Jersey.

Halictus (Chloralictus) lepidii, n. sp.

Female. Length about 4.5 mm. Head and thorax dark green, abdomen dark brown. Antennæ dark with testaceous tips. Facial quadrangle longer than broad, plainly narrowed below. Clypeus produced more than half its length beyond the eyes. Punctures on front and sides of face small and close together, those on supraclypeal area larger and farther apart; on the clypeus they become much coarser towards the base, which is dark purple. Sides of face with short sparse whitish pubescence. Mesonotum with fine pucntures, close on top, more scattered along the sides. Metathorax coarsely punctured. Scutellum much more finely and closely punctured than the adjoining portion of the mesonotum. Propodeum truncate with smooth rounded angles. Disk with inconspicuous short plicæ. No rim. Abdomen ovate. First two segments smooth and shining with whitish hairs on the sides. Remaining segments covered with short, sparse pubescence. Extreme apical margin of each segment faintly testaceous. Front wing about 3 mm. long, somewhat dusky. Tegulæ black and shining, lighter on top, with inconspicuous sparse punctures. Veins dark, stigma dark testaceous. Second submarginal cell about as long as

high, much narrowed above. Third submarginal over one and one-half times as long as the second on the marginal vein. Legs dark, clothed like the rest of the body with pale pubescence.:

Male. Differs from the female as follows: Mesothorax of a lighter green and more shining. Abdomen black, long, very slender, smooth and shining above along its entire length. Facial quadrangle much narrower below. Face below antennæ with a dense covering of short white pubescence. Antennæ below testaceous from third joint on. Third antennal joint a little longer than second. Tegulæ more closely punctured. Ridges on disk of propodeum shorter and less distinct. Wings clearer, stigma and veins darker, the latter more sharply defined. Second submarginal cell shorter.

Described from twelve males and fourteen females captured at South Miami, Miami, Cape Florida (across the bay southeast of Miami), Golden Beach and Hollywood (both north of Miami). They were visitors to the flowers of *Lepidium virginicum*, *Warea Carteri*, *Galactia pinetorum*, *Sida carpinifolia*, *Chrysopsis Tracyi* and *Alternanthera floridana*. Type and allotype in the author's collection.

In the Sandhouse Key to females this species runs next to *ellisiæ* Sandhouse from Massachusetts (**3**,11), but differs mainly in the following characters: antennæ testaceous at the tips, scutellum closely punctured all over (no smooth spots on the disk), tegulæ slightly testaceous above, disk of propodeum with ridges on basal half.

H. (Chloralictus) nymphalis F. Smith

Described from St. John's Bluff, East Florida (4,68.) There are in my collection specimens from Miami, South Miami and Hollywood (north of Miami) and also one from Jacksonville (near the type locality) captured September 25, 1925. At South Miami it flies with slight interruption throughout most of the year, but seems to be present in greater numbers during the fall months. It has been taken at the flowers of *Opuntia austrina*, *Croton linearis*, *Galactia pinetorum*, *Lepidium virginicum*, *Warea Carteri*, *Chrysopsis Tracyi* and *Portulaca oleracea*. It prefers

sandy soil, and will probably be found in suitable locations along the entire East Coast of Florida.

H. (Chloralictus) longiceps Robertson

Described from the female (5,272). This species is easily recognized on account of its long, narrow head with the strongly produced clypeus, and the swollen upper portion of its occiput.

Male. Face narrower and longer than in the female, covered to a little above the antennæ with short loose pubescence. Face above the antennæ, and vertex with a brassy tinge. Antennæ slightly testaceous underneath from the third joint on. Third antennal joint longer than second, fourth nearly as long as second and third combined. Wing veins darker and more clearly outlined than in the female. Abdomen slender, black and nearly bare except near the tip. Tarsi white, the last joint brownish.

The time of flight of the females covers the entire year. Males and females have been taken at Miami, South Miami and Hollywood at the flowers of *Croton linearis, Warea Carteri, Lepidium virginicum, Pycnothymus rigidus, Opuntia austrina, Galactia pinetorum, Laciniaria gracilis, Mikania batatifolia, Chrysopsis Tracyi* and *Solidago angustifolia.*

Halictus (Chloralictus) halophitus n. sp.

Female. Length 5.5 mm. Head and thorax dark green and shining. Abdomen ovate, dark brown with narrow, hardly perceptible testaceous margins. Dirty-white pubescence of body sparse and short, longer on sides of thorax and femora. Face longer than broad, narrowed considerably below. Clypeus produced nearly its entire length beyond the eyes. Punctures of the face delicate and close together, those of the supra-clypeal area and clypeus coarser and less numerous. Clypeus with a purplish reflection, mandibles reddish beyond the middle. Apical region of antennæ faintly testaceous. Mesonotum finely and closely punctured on a slightly roughened surface. Mesopleuræ coarsely sculptured. Tegulæ shining, light testaceous, rounded in front, nearly straight behind. Front wing about 3.8 mm. long. Wings somewhat dusky, veins dark testaceous, stigma much

lighter. First submarginal cell nearly as long as second and third together. Second considerably shorter than third, narrowed one-third towards the marginal. Disk of propodeum without a rim, narrowed towards the apex to such an extent as to appear somewhat triangular. Its surface finely granular, with a distinct median ridge, and about 8 lower and much shorter ones on each side. Legs dark, knees and tarsi testaceous. Abdomen shining throughout, especially the first segment, which is smooth. Remaining segments with indistinct scattered punctures.

Male. Inner orbits straighter than in the female, especially above. Face densely covered with a short white pubescence beneath the antennæ and on the sides above. Mandibles slender, very light testaceous, tips blackish. Labrum light testaceous. Antennæ dark on upper surface, reddish underneath from the second joint on. Third joint longer than second. Mesonotum and scutellum shining, nearly bare. Ridges on disk of propodeum more numerous but less prominent than in the female. Knees, tips of tibiæ and tarsi light yellow. Abdomen slender, very shiny with metallic reflections. Apex of first segment convex, forming a distinct depression between it and the second segment.

Described from six males and seven females taken April 20, May 20 and August 15 at Cutler, south of Miami, on the flowers of *Bramia Monniera* and *Sesuvium maritimum*. Type and allotype in the author's collection.

The low marshy grounds in this locality border on Biscayne Bay. On account of the influence of high tides and occasional storms which drive the water up over the shores, the soil supports a typical halophytic (salt-loving) plant association, and the two species mentioned above (Bramia and Sesuvium) form low carpet-like patches between the shrubs and small trees inhabiting the dryer portions of the marsh.

This species seems to be most closely related to *tropicior* Ellis, from Guatemala (8,219), but the female differs from that of tropicior as follows: clypeus produced nearly its entire length beyond the eyes, punctures uf mesonotum closer together (not scattered as in tropicior), abdominal segments with testaceous margins.

H. (Chloralictus) rhododactylus D. T.(*fulvipes* F. Smith)

A female captured July 19, 1916 at Homestead (28 miles south of Miami) evidently belongs here. Type locality: St. John's Bluff, East Florida (**4**, 67). This specimen agrees well with the original description, as also with the notes furnished by Cockerell (**9**, 351), who examined the type in the British Museum. I have never come across it since, and it seems to be a rare insect in this part of Florida.

H. ligatus Say.

For this species Robertson has proposed the genus Odontalictus (**7**, 91) on account of the cheek of the female being produced into a tooth. It is by far the most common bee of our surroundings, flying throughout the year, and visiting a great variety of flowers, especially Compositæ. Robertson (**6**,322) has given a synonomy of this widely distributed and variable species, and pointed out that the specimens from Florida belong to the form described by F. Smith as H. capitosus (**4**, 67).

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EVIDENCE IN SUPPORT OF THE OLFACTORY FUNCTION OF THE ANTENNÆ OF INSECTS.[1]

By R. W. Gláser

1. *The Present Status of the Problem.*

Investigators agree that chemotropism or the reaction of an animal to chemical stimuli plays a very important role in the biology of insects. Richardson (1) recently reviewed the extensive literature on odor as a factor in the selection of places for oviposition and in the choice of food. Odor likewise assists insects in gathering material for their nests, in detecting members of their own or "alien" species, and in bringing the sexes together.

The assignment of the sense of smell to particular organs has been beset with great difficulties. Most histologists assign the olfactory sense chiefly to the antennæ. On these organs sensillæ are found in the form of pits, cones or plate organs which are morphologically of such a nature that a chemoreceptor function has been attributed to them. Similar sensillæ may occur in other places, as on the maxillary and labial palpi, on the cerci and perhaps elsewhere, but they seem generally to be numerically greatest on the antennæ. Correlations between the number of antennal sensillæ and the habits of certain insects have disclosed a number of facts. The antennæ of Diptera that oviposit on putrid meat or feces harbor many olfactory pits whereas phytophagous forms possess few. Bloodsucking flies have many, as do those forms whose larvæ are parasitic, such as Oestrids, Bombyliids and Tachinids. The Hymenoptera possess enormous numbers of antennal sense organs. In male honey bees the number of plate organs has been computed at 30,000. In Odonata, large-eyed forms that prey on other swiftly moving insects, the number of antennal olfactory sense organs is small. Among those species where sexual dimorphism of the antennæ exists, these organs are generally more fully developed in the males than in the females. This seems to be associated with the more

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aggressive nature of the males and assists them to find the opposite sex even at great distances.

Contributions on the habits of certain moths by Forel (2) and Riley (3) and the extremely interesting deductions made from careful observations on the life of ants by Forel (2), Wheeler (4), Lubbock (5), Bethe (6), Wasmann (7), Fielde (8), and others seem to demonstrate that the antennæ serve as tactile and olfactory organs. The results of these investigators may be briefly summer up. They chiefly considered the behavior of insects when subject to various stimuli, such as the exploratory movements of the antennæ when the creatures are searching for food or for proper places to lay their eggs; the antennal movements and subsequent behavior of insects when encountering members of their own or "alien" species; the part the antennæ play when the animals are attempting to find their way to their nests and back to the forage supply; the trilling of the antennæ by males in the presence of females, etc.

Experiments to prove the above contentions are not lacking. Forel showed that certain insects which appear to find their mates by smell are unable to do so when the antennæ are amputated. Kellogg (9) showed that when one antenna is removed from silkworm moths, they always turn towards the source of odor stimulation in the direction of the remaining antenna. Barrows (10) demonstrated that Drosophila is unable to respond to odors when the last segment of the antennæ is removed. Von Frisch (11) trained bees to come to an odorous food supply. When the antennæ were amputated the bees could no longer find the food. In order to prove that this failure was not due to any general constitutional effects of the operation, he trained other bees to associate the food with a particular color. When the antennæ of such bees were removed they promptly found the food. Minnich (12) in some experiments on the cabbage butterfly found that the antennæ were olfactory organs but not the only ones. Most of the experimenters referred to agree that some insects will still respond, but much more slowly, to odors after the antennæ have been removed or coated with substances impermeable to volatile materials. This seems to show that olfactory organs are also located in other regions of the body.

McIndoo (13) entirely discards the view that the antennæ function as olfactory organs. This investigator has done much work on this subject and has experimented chiefly with beetles, bees and ants. McIndoo considers the abnormal behavior of insects towards odor when the antennæ are amputated, but thinks this is due to the fact that such insects are abnormal in their whole behavior. This is, of course, contrary to von Frisch's careful experiments and, if true, would apply equally to McIndoo's own work. Any animal that has been deprived of a sense organ will react abnormally with respect to a stimulation that affects this particular organ. McIndoo finds that olfactory pores exist in other regions of the body, especially at the bases of the wings and legs. When these pores are varnished over the insects respond much more slowly to odors than do those whose antennæ are amputated. Kennedy (14) recently carefully weighed the evidence for and against the antennal sense of smell and thinks that while olfactory receptors undoubtedly do occur on other parts of the body, the experimental evidence against the older theory of an antennal sense of smell is insufficient. Judging from the literature, it seems that much substantial evidence exists in favor of the older theory. However, since roaches are exceedingly favorable material for a study of this question and furnish another rather lucid illustration in support of the older view, the writer feels prompted to report some observations.

2. *Observations and Experiments on Periplaneta americana.*

Periplaneta americana, the large American roach, carries two extremely long antennæ on which occur the so-called olfactory cones. The maxillary and labial palpi of this species also bear sense organs which were, likewise, considered by Graber to function in the detection of odors. It was noticed by us that the antennæ of starved roaches moved continuously when some odorous food was tendered but held at a distance to prevent contact. This then led to the performance of some further experiments which would demonstrate whether the antennæ harbored chemoreceptors. Full grown male and female roaches were placed in an atmosphere containing a slight amount of ether vapor. After a minute or two the insects began to behave

in a curious manner. First one antenna was pushed down with the fore legs, caught near the base and rapidly passed through the mouth parts clear to the tip when it was released and the procedure repeated with the other antenna. This apparent cleaning of the antennæ continued indefinitely, or until the animals became completely anaesthetized. The maxillary and labial palps were also frequently drawn through the mouth. The same reactions occured when carbon tetrachloride vapor or bromine was used. Two inert esters, ethyl acetate and amyl acetate (banana oil) produced identical reactions. The animals simply responded to these volatilized substances with their antennæ and palpi. No other reactions occurred until the anaesthetic effect through the spiracles became noticeable. These experiments, it seems to us, signify that chemoreceptors are located on the antennæ and on the maxillary and labial palps. This, however, does not necessarily mean that these chemoreceptors are those of smell. The reactions obtained might very easliy represent merely the effect of violent chemical irritations such as the reaction of the human eye to onion oil or the reactions of the mucous membrane of the human mucosa to pollen particles. It seems unlikely, however, that two such inert substances as amyl and ethyl acetate could produce much irritation aside from exciting perhaps an obnoxious odor sensation in the insects. Nevertheless, insect sense organs are constructed differently from those of higher animals. Their surfaces, as pointed out by Kennedy, are often external and on long processes. They are also dry and consequently the direct contact with a chemical stimulus, not first dissolved in mucous secretions, may explain the differences in behavior and the reason for the great sensitivity to such stimuli. To meet the objection of simple chemical irritation and to prove that olfactory sensations are received through the antennæ some additional experiments were performed.

Two roaches with perfect antennæ were segregated in an oblong cage having a glass top and a corked hole on each of two ends. These holes were ordinarily used for the introduction of food and water. Another pair of roaches with their antennæ amputated at the base was placed in a similar cage. Each cage was completely divided in half by a double layer of a fine mesh

copper screen, producing two compartments, one for the roaches the other empty. The roaches were then held for two days to permit the operated ones to recover from the effects of the amputation. During this time they were given nothing but water in order to create an intense hunger. On the second day the insects seemed perfectly normal and a small piece of Roquefort cheese, for which these animals manifest a great fondness, was placed in the empty compartment one inch from the copper screen. In a few seconds the normal insects, which were huddled in a far dark corner, began to move their antennæ and within two or three minutes one began to move over towards that part of the screen from which the cheese odor emanated. This one waved his antennæ about near the cheese, but not being able to touch it soon returned to the corner. A little later the other roach followed the same maneuver. Both insects repeated this behavior three to four times. During the entire length of these operations, the roaches with amputated antennæ gave no response and when they moved they progressed along the side opposite the cheese which happened to be the darker side. During these tests both cages were held in the same position and at the same distance from the source of light. The cheese and the roaches were then removed and the cages washed thoroughly to remove all odors.

In a few days the roaches were again placed in their respective cages, and after the animals had been starved again for two days some Roquefort cheese was smeared on each cork plugging the hole of the compartment containing the insects. Within one to two minutes the normal roaches ran over to the soiled cork and ate off the cheese. The roaches with amputated antennæ did not respond. After more than two hours they finally came across the cheese, waved their palpi and ate. It seems that the antennæ receive smell impressions at considerable distances and that the maxillary and labial palps can only perceive an odor when the insects are in close proximity to the volatile substance. The antennæ, maxillary and labial palpi were removed from another group of roaches. After recovery from the operation, and after the customary starvation, they had even greater difficulty in finding the cheese than those

roaches with simply the antennæ amputated. They did not perceive the cheese until it was placed under their mouth parts, when they carefully tasted it before eating.

Another experiment appears significant. If the end of a stick is smeared with cheese and held at a distance of about one inch from the head of roaches with amputated antennæ nothing occurs. When the same stick is held at the same distance from the head of the normal roaches the antennæ follow the movements of the stick until they touch it, much like the pursuit of a magnet by a piece of iron. If one antenna is removed and the other left intact and the contaminated stick is held alternately on the right and left side of the head, the response occurs in about half the time on the unoperated side than on the other.

Naturally cheese is not the only substance that produces the above reactions. Dog biscuit will cause an identical response in starved roaches, but more tardily due to the much slighter odor emanating from this food.

Roaches are gregarious animals and are often found huddled together in enormous numbers. These insects emit a strong species odor rather disagreeable to humans. This odor is probably responsible for their gregarious habit. During the course of our experiments, it was noticed that those insects with the antennæ removed did not huddle as readily as was the case with the unoperated ones. After huddling the roaches with antennæ were separated by disturbing them with a prod. In approximately one-half minute they were usually found together again. Those with amputated antennæ remained separated until they accidentally ran into one another.

All of the roaches operated upon are alive up to the present (six weeks after the experiments). They behave perfectly normally in so far as their appetite is concerned and the females have deposited several egg capsules. That they are abnormal with respect to the function of smell is a foregone conclusion, but it would certainly require a stretch of the imagination to assert that they were abnormal in all their behavior.

3. *Conclusions.*

Chemoreceptors are located on the antennæ, maxillary and labial palps of *Periplaneta americana*. The antennæ are the most

efficient organs in detecting odor stimuli, especially from a distance. This does not imply that olfactory organs do not exist elsewhere on the body.

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THE *TRICYPHONA INCONSTANS* ON NANTUCKET ISLAND, MASS.

By Charles W. Johnson.

Boston Society of Natural History.

While collecting insects along the margin of Upper Hummock Pond, Nantucket, June 25, 1926, I collected some specimens of this common species. I did not examine these carefully until my return home and was then surprised to find that the two or three I had pinned had an unusual number of supernumerary cross-veins in the second submarginal cell (cell 4), whereupon I went over the sweepings from that locality and found in all 15 specimens, all having the supernumerary cross-veins confined to cell 4. The numbers of the supernumerary cross-veins in the right and left wings are given in the following table.

No. speciment	Right wing.	Left wing.
1 (Fig. 1)	7	3
3	4	3
1	3	4
2	3	3
3	3	2
1	3	1
2	2	2
1	1	2
1	1	1

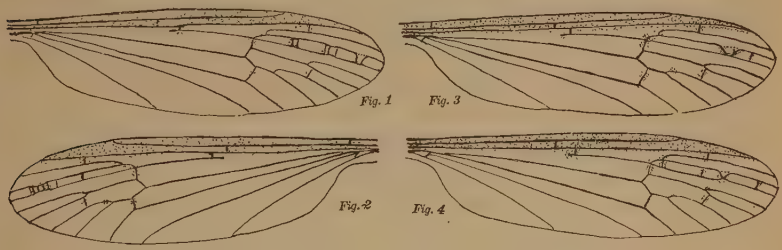
Visiting this place again on July 16 I was unable to find a single specimen. The locality was again visited June 7, 1927, and five were obtained showing the following variation.

No. Specimens	Right wing.	Left wing.
1 (Fig. 2)	7	4
1	3	3
1	1	3
2 with normal vanation.		

On June 22, 1927, at the same locality 18 specimens were taken, showing the following variation.

No. specimens.	Right wing.	Left wing.
1	4	6
1	5	2
1	4	4
2	4	3
1 (Fig. 3)	3	4
2	3	3
1 (Fig. 4)	5	2
1	4	1
1	3	2
1	2	3
1	2	2
2	1	2

1 with normal venation.
1 with discal cell open on the left wing.
1 with the first submarginal cell (cell 3) normal on the right wing, but on the left wing of the same length as cell 4.



Figs. 1-4. Wings of *Tricyphona inconstans*.

In 1901 I published a paper on the variation of this species (Entom. News, vol. 12, p. 305) but the material at hand was from various localities and as usual only a small percentage of the specimens taken showed abnormal venation. To find therefore a locality where the conditions were reversed seemed very remarkable, and that the supernumerary veins should all be confined to cell 4 was likewise interesting. In examples where the supernumeraries are numerous or where some of them are oblique there is a tendency for the longitudinal veins to be imperfect. This part of the vein is indicated by dots in the accompanying figures. If this species could be readily bred it would form an interesting subject for a study in genetics.

THE NORTH AMERICAN SPECIES OF RYBAXIS

By H. C. Fall,
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The little group Rybaxis, call it genus or subgenus as you prefer, was established by Saulcy in 1874 to contain a few species definitely separable from Bryaxis by the presence of a sharply impressed biarcuate groove connecting the lateral pronotal foveæ, and a deep submarginal stria on the vertical flanks of the elytra. At that time two species only were known in our fauna which possessed the characters of the new genus, viz.—*Bryaxis conjuncta* described by Le Conte in 1850, and *B. clavata* described by Brendel in 1865 as a supposed "northern climatical form of *conjuncta*, but declared by him the year following to be a distinct species, differing from *conjuncta* in certain sexual characters, notably in having the anterior trochanters armed with a short sharp spine, the same being unarmed in *conjuncta*. In the Crotch Check List of 1873 Dr. Horn changed the name *clavata* to *brendelii*, the former being preoccupied.

On page xli of the Horn Bibliography by Henshaw (Trans. Am. Ent. Soc. 1898) there is a synonymical note from Mr. Schwarz pointing out that while Dr. Brendel had discovered that there were two distinct species included under the name *Bryaxis conjuncta*, one with the front trochanters of the male spined, the other not, through a failure to read Le Conte's original description Brendel in describing his *clavata* with spined trochanters succeeded only in rediscribing Le Conte's *conjuncta*, thus leaving without a name the species with simple male trochanters which he had wrongly assumed to be the true *conjuncta*. Oddly enough Le Conte himself, apparently completely forgetful of his original description, follows Brendel's lead and in his table of the genus in the "Transactions" of 1880 uses the name *conjuncta* for the species with simple male trochanters.

The Schwarz note of nearly thirty years ago however seems to have been generally overlooked and the error there pointed out still awaits adjustment; moreover some recent study by the

writer of available Rybaxis material shows that the problem is not quite so simple as at first supposed, for instead of having to do with two species only, I have discovered that we have at least half a dozen species that pass under the old names, of which several satisfy about equally well the descriptions of *conjuncta* and *clavata.*

Obviously, before further progress can be made, it becomes necessary to determine just what *conjuncta* and *clavata* really are. This has been done with the highest degree of probability possible by a critical study of the respective series under these names in the Le Conte and Brendel collections. As a result of this determination, *conjuncta* and *clavata,* supposed by Schwarz to be identical, prove to be quite distinct species.

All our species of Rybaxis are superficially very similar, and for the most part are only recognizable with certainty by the secondary sexual characters of the males, the females by themselves being often indeterminable. In all our species the males have the anterior tibiæ acutely dentate within above the middle, and in most of them the antennal Club is enlarged and otherwise modified, and the anterior trochanters are apically spined or toothed in this sex. In addition to these characters, all of which are given in the books, the early descriptions of *conjuncta*(1850) and *clavata* (1866) record the presence in the male of acute metasternal processes. These are usually invisible in mounted specimens, and both Le Conte and Brendel seem to have forgotten all about them, for they make no mention of them in their later writings when speaking of sexual characters nor do any subsequent authors appear to have noted their existence.

In the examination of my material I have discovered still another and most remarkable structure which seems to be present with modifications in the males of all species of this genus, and which hitherto has apparently entirely escaped observation. This consists of a very small thin ligula arising perpendicularly from the rear margin of the second ventral segment for a short distance, then abruptly bent forward and more or less expanded into a thin nearly horizontal plate, variable in form and size according to the species, and sometimes to a lesser degree individually. The form of this ventral plate, the position and form

of the metasternal processes, the modifications of the antennal club, and to a less extent the distance apart of the dorsal abdominal carinæ, constitute the chief diagnostic characters used in the table following. Color is of no value whatever, all species probably varying from pale dull yellow to blackish with elytra of some shade of red or brown. Likewise the ordinary distinctions in size, form and sculpture are so slight as to be of little or no use in determining the species.

Table of Species.

1. Median pronotal fovea larger, spongiose pubescent. . . *valida.*
   Median pronotal fovea small, nude. 2
2. Antennal club a little larger in the male, the last joint with an oblique tooth beneath near the base; dorsal abdominal carinæ unusually approximate, being separated at base by only about one fifth the discal width of the segment. 3
   Antennal club in the male with last joint not toothed beneath. 4
3. Metasternal processes posterior in position, feebly developed, consisting merely of obtusely rounded tumidities; ventral plate small, subquadrate. . . . . *truncaticornis.*
   Metasternal processes long and acute, similarly posterior in position; ventral plate lacking, but in its place an obliquely erect parallel sided laterally compressed process, its summit blunt. . . . . *obliquedens*
4. Antennal club in the male stouter and more cylindrical, the lower surface flattened and more or less asperate. 5
   Antennal club not appreciably modified in the male. 8
5. Pronotum of male more angularly prominent at middle of hind margin; metasternal processes rather widely truncate at apex as viewed from the side. . . . . *conjuncta*
   Pronotum much less prominent medially behind, the metasternal processes acute. 6
6. Metasternal processes more nearly median in position; ventral plate moderately transverse, less than twice as wide as long, truncate in front, and either subangulate or

rounded posteriorly; dorsal abdominal carinæ separated at base by slightly less, and at apex by very nearly one-third the discal width of the segment. . . . . *clavata.*

Metasternal processes posterior in position. 7

7. Ventral plate of male very strongly transverse, typically fully three times as wide as long; dorsal abdominal carinæ separated even at base by distinctly more than one-third the discal width of the segment. . . . . *transversa.*

Ventral plate of male very small, more or less rounded behind, truncate in front, a little variable but usually about as long as wide; dorsal abdominal carinæ separated at base by slightly less than one third the discal segmental width. . . . . *mystica.*

8. Metasternal processes of male anterior in position, widely separated, strongly developed and acuminate; dorsal abdominal carinæ separated at apex by one-third the discal segmental width. . . . . *varicornis.*

Metasternal processes anterior, short, closely approximate, and blunt at tip; dorsal abdominal carinæ separated at apex by one-fourth the discal segmental width. *geminata.*

Metasternal processes posterior, feeble, being merely obtuse tumidities; dorsal abdominal carinæ separated by only about one-fifth the discal segmental width. . . . . *arkansana.*

Rybaxis valida Brendel.

This species is our only one having the median pronotal fovea pubescent and is instantly recognizable thereby. The antennæ are rather slender, all joints, including those of the club, longer than wide, the latter not modified in the male. The dorsal abdominal carinæ are plainly more widely separated than one-third the discal width of the segment. The ventral plate, in the single male at hand in which it can be seen, is quadrate and slightly wider than long. The male front trochanters appear to be unarmed. The size is slightly larger than in any of our other species.

Described from New York and Illinois; specimens before me are from the latter state.

Rybaxis truncaticornis Brendel.

This species was described by Brendel in two lines as a variety of *conjuncta*, as he understood the species. It is however entirely distinct in numerous respects from the supposed as well as the true *conjuncta*, differing from all our other species except the next by the oblique tooth on the lower surface of the last antennal joint in the male. The anterior coxæ of the male are armed with a small apical tooth.

The type locality is Iowa, and all specimens seen by me are from that state; most, if not all of them taken at Iowa City and distributed by Prof. Wickham.

Rybaxis obliquedens sp. nov.

Closely related to the preceding species by the oblique tooth of the terminal joint of the antennæ in the male, and the more than usually approximate dorsal abdominal carinæ; but the metasternal prominences which in *truncaticornis* are feebly developed, are here long and acute. In the form of the process arising from the second ventral segment, with its total lack of a surmounting horizontal plate the present species is unique among our representatives of the genus. The anterior trochanters of the male are armed with a long slender spine instead of a short tooth as in *truncaticornis*.

Seven examples of this species are before me, all sent by Mr. Liebeck. These include 1 ♂ and 4 ♀s from "Pa." (vicinity of Philadelphia), 1 ♂ from Burlington, Iowa) and 1 ♂ without locality. The Pennsylvania male is taken as the type.

Rybaxis conjuncta Le Conte.

The peculiar greater angular prominence of the pronotal disk at the middle of the hind margin in the male, and with it a correspondingly more pronounced angle at the middle fovea between the parts of the biarcuate groove, distinguish this species from all others. This character is only feebly indicated in the female. All three joints of the antennal club in the male are sparsely asperate beneath; the dorsal abdominal carinæ are sep-

arated by ⅓ the discal segmental width or possibly slightly more (at their apex); the anterior trochanters of the male are acutely toothed at apex; and the apices of the metasternal processes are rather widely truncate. This is one of our larger species and is only equaled or perhaps slightly exceeded in size by *valida* and *transversa* n. sp.

Le Conte's original specimens were described from "provinciis orientalibus." The only specimen at present in his series which could possibly have served as his type in 1850 is a male of the present species and bears a colored locality disk which signifies Massachusetts or possibly New England. There are in my collection four examples from Three Mile Island in Lake Winnipesaukee, New Hampshire, and I have seen other specimens from Mass.; N. Ill.; Canada (Toronto and Ottawa); Idaho (Coeur d'Alene); and one in Mr. Liebeck's collection labeled "Cal."

Rybaxis clavata Brendel.

Antennal club in the male much enlarged, subcylindrical, flattened beneath, blackish except toward the tip, 9th and 10th joints nearly or quite twice as wide as long, the flattened lower surface strongly asperate almost throughout. Dorsal abdominal carinæ separated at tip by ⅓ the discal width of the segment. Anterior trochanters armed with a slender spine. Metasternal prominences finely acute and more nearly median in position than in any other species. Ventral plate about 1-2 wider than long, truncate in front, narrowed posteriorly.

In his original description of *clavata* Brendel gives no specific locality, but merely states his belief that it is a northern form of *conjuncta*. Later, in his 1890 monograph, he gives as localities "Pa. and Ill." in the table of species, and "Region of the Great Lakes" following his description.

Rybaxis transversa sp. nov.

This species is distinguishable from all others by the very strongly transverse ventral plate, which is nearly or quite three times as wide as long, the vertical lamina supporting it of nearly

equal width, but very short. The antennal club of the male is of the same type as in *clavata* but not quite so stout, the 9th and 10th joints not quite equalling the 11th in width and each less than twice as wide as long, the apical joint asperate beneath, but the 9th and 10th free from asperities except a few marginal ones. The dorsal abdominal carinæ are long and strong, the intermediate surface rather strongly impressed along their inner sides, and their distance apart is appreciably greater than 1-3 the discal segmental width. The anterior trochanters of the male are armed with a rather short acute apical tooth. The metasternal processes are strong and subacute at apex, sometimes a little obliquely so.

This is one of our larger species and is of nearly the same size as *conjuncta*.

The type is a male selected from a series of specimens collected at Springfield, Mass., by Mr. Jas. H. Emerton. There are also in my collection a male specimen from Aweme, Manitoba, and a pair taken by myself at Anchorage, Alaska, these last recorded as *brendeli* var. in my recent Alaska List (Pacific Coast Ent. Jan. 1926). I have seen other examples in Mr. Liebeck's collection from "Canada," Franconia N. H., and Westville, N. J.

Rybaxis mystica Casey.

The antennal club of the male is of the same type as in *clavata* and *transversa*, and agrees very nearly with that in the last named species; the interior flattened area of the 9th and 10th joints is free from asperities except a few around the margins, the 11th joint distinctly asperate. Dorsal abdominal carinæ separated at tip by 1-3 the discal segmental width, the carinæ rather shorter, less strong, and the adjacent surface within them less impressed than in *transversa*. Anterior trochanters of male with a rather long spiniform tooth. Metasternal processes posterior, acuminate at apex. Ventral plate very small, truncate in front, more or less narrowed behind, and varying from slightly wider than long to as long as wide. Average size a little smaller than in *transversa* and *conjuncta*.

The above characters are taken from a series of specimens

in my collection from Tyngsboro Mass. and Kittery Point, Maine. A male from the last named locality sent to Mr. L. L. Buchanan at the National Museum for comparison with Casey's type he finds to be closely in agreement therewith in all essentials. In his description Casey says the terminal antennal joint is as long as the four preceding, but careful measurements made by Mr. Buchanan prove it to be distinctly shorter than the four preceding joints, as is usual. Casey's unique type is from Rhode Island.

Rybaxis varicornis Brendel.

Very similar to *Mystica* and scarcely separable except by the male characters, the females being virtually indistinguishable. The antennal club in the male does not differ from that in the female. Dorsal abdominal carinæ as in *mystica*; anterior trochanters of male unarmed; metasternal processes anterior in position, behind the middle coxæ, well separated; ventral plate very small, as long as or slightly longer than wide, narrowed in front.

This is the species which Brendel erroneously assumed to be the *conjuncta* of Le Conte, and which he distinguished from *clavata* by its unmodified antennal club and simple anterior trochanters in the male. The name *varicornis* was proposed for a variety with the terminal joint of the club yellow. This paler last joint is by no means peculiar to the present species, but occurs not rarely in at least three or four others, usually in the darker colored specimens. The name *varicornis* is used for this species because available, though very little credit attaches to Brendel for his connection therewith.

This is a common species in Massachusetts, and ranges westward through southern Canada at least to Illinois. It is probably more widely dispersed, but the confusion of species in this genus renders many of the records uncertain.

Rybaxis geminata sp. nov.

Antennal club not differing in the sexes; dorsal abdominal carinæ separated at tip by ¼ the discal width of the segment;

anterior trochanters of male with a minute denticle beneath, well back from the apex; metasternal processes anterior, short, rather blunt and closely approximate; ventral plate subrectangular and rather less than twice as wide as long. The short anterior approximate metasternal processes are unique in the genus, and the tooth of the front trochanters is more minute and more remote from the apex than in any other species.

The type (♂) is one of four specimens from St. Vincent Pa., submitted by Mr. Liebeck, who kindly permits me to retain it.

Rybaxis arkansana sp. nov.

Antennal club unmodified in the male; dorsal abdominal carinæ separated at base by not more than 1/5 the discal width of the segment; anterior trochanters of male with a small apical tooth; metasternal prominences posterior in position, but ill developed and consisting merely of rounded tumidities; ventral plate small, evidently transverse in the type, but apparently as long as wide in a second specimen.

This is one of the smallest species of the genus, and sufficiently distinct by the tabular characters.

Described from two males from Arkansas (Carlisle) collected many years ago by Stromberg.

OBSERVATIONS ON THE ICHNEUMON-FLY *EPIURUS PTEROPHORI* ASHMEAD.

By Magel C. Wilder.
Cornell University, Ithaca, N. Y.

The stalks of the evening primrose (*Oenothera lamarckiana*) are very commonly found infested with larvæ of the moth, *Lophoptilus eloisella*. These larvæ are borers in the pith cavity of the stalks. They hibernate in the stalks. In autumn each larva prepares itself a hibernation chamber in the stalk by setting off a section of the empty pith cavity by building two partitions of frass and silk a little further apart than the length of its own body, and by lining the chamber so formed with a thin transparent film of silk. On splitting apart the pith cavities in autumn a number of such chambers may often be found in a single stem. But in some of these chambers, instead of the yellow moth larva there is found the whitish larva of a rather large hymenopterous parasite. The rearing of this parasite was undertaken at the suggestion of Professor James G. Needham and continued under his kindly direction. It proved to be the larva of the ichneumon fly, *Epiurus pterophori*.

The evening primrose grows wild in vacant lots, and was gathered in a number of places at Ithaca, N. Y. The stalks were first brought into the laboratory and examined on March 13th. The moth larvæ were found distributed throughout the stalks, occurring very frequently. The larvæ of *Epiurus pterophori* were found to occur, seldom more than one in a stalk in a very small percentage of the stalks examined. Primrose stalks collected from certain places contained none. It is always found within a hibernation chamber but in no particular region of the stalk, and the head capsule together with other skin fragments of Lophoptilus have been found with it. This indicates the parasitic nature of *Epiurus pterophori*.

The larva is yellowish-white, flattened dorso-ventrally, and reposes normally in its cell in a curved position. The larvæ measure from six to seven millimeters in length and are about one millimeter in breadth. Four narrow chitinized plates are

found on the dorsal surface of the head. By these characteristics it is readily distinguished from the moth larva.

Before pupating the larva forms a silken web of loose texture within the cell of Lophoptilus. It is within this silken network that the pupa is formed and remains until it emerges as the imago through the stalk. The pupa is 7.5 to 8 millimeters long and 1.5 millimeters broad.

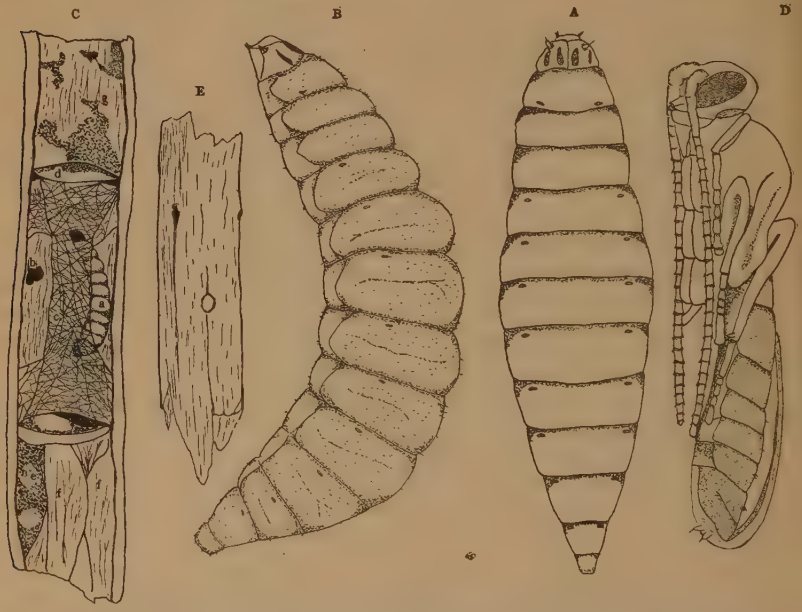

Fig 1. A, Dorsal view of larva of *Epiurus pterophori* Ashmead; B, Lateral view of larva showing normal curved position; C, Longitudinal section of stalk of *Oenothera lamarckiana* showing:– *a*, Larva in web of silk within cell; *b*. Head capsule of *Lophoptilus eloisella*; *c*, Silken web; *d*, Partition; *e*, Frass deposit in pith cavity of stalk; *f*. *f*, Pith cavity.

Larvæ were found in stalks collected and examined throughout March and April. The first pupa was found within the stalk March 22nd from material which had been inside the laboratory for a week. Pupæ were found to exhibit a great deal of activity; some were able to turn their bodies completely over within the cell.

The first adult was found March 29th in a stalk that had previously been slit open to show the larvæ. The insect was

left within the cell in which it was found, the upper surface of the stalk replaced, and both fastened securely together. This section of the stalk was kept under observation in a cheese-cloth covered battery jar. The adult emerged through a small round hole it had made in the stalk a few days afterward.

The adult was identified by Dr. J. Chester Bradley as *Epiurus pterophori* Ashmead. It is known also in literature as *Pimpla pterelas*, *Pimpla pterophori* Ashmead, and *Scambus pterelas*. Notes kindly given by Dr. Bradley indicate that it is "parasitic on larvæ of stem-boring and stem-gall-making Lepidoptera and Coleoptera such as *Gelechia gallæ-solidaginis*, *G. gallæ-asterella*, *Pyronata nubilalis*, and *Stagmatophora ceanothiella*. In literature it is also recorded as a parasite of *G. gallæ-asterella*, and the beetle *Mononychus vulpeculus*."

A description of the adult may be found in Walsh.

Epiurus pterophori has been mentioned as having been found feeding on the pupa of the European corn-borer.[3] According to the description: "the hymenopterous larva of *Epiurus pterophori* was found feeding on the internal juices of a *P. nubilalis* pupa which had been broken open. The full-grown parasite larva spun a brown silken cocoon and pupated within the remains of its host. Only two of these parasites were bred."

Although a pale silken web was found to be spun by the parasite, it was not such that could be described as a "brown silken cocoon" as is described above.

By the first of June all of the adults had emerged. The adults were transferred to breeding cages containing evening primrose plants. Although an attempt at oviposition was noted on the part of one female against the glass wall of the battery jar, none was observed after they were placed with the evening primrose plants. No mating was observed; and no feeding, although several sorts of food were offered, first sugar and water solution, and later small insects, placed in the cages. The adults lived for but a few days, during which time they were moderately active.

Literature Cited.

(1) J. Hamilton: Ent. News. 1894-'95, pp. 287-288.
(2) Walsh: Trans. Acad. Sci. of St. Louis III, 1873, pp. 1, 133.
(3) Mass. Ex. Sta. Bull. 189, p. 58, 1919.

NEW NEOTROPICAL THYSANOPTERA COLLECTED BY C. B. WILLIAMS. II[1]

By J. Douglas Hood,
University of Rochester.

The earlier paper of this series was published in Psyche, Vol. XXXII, pp. 48-69, 1925, and made known five new genera and thirty-six new species. During its preparation several doubtfully distinct forms belonging to difficult genera were reserved for further study. Thesee—leven in number—and one new genus, are described below. Two are named after their collector, whose careful field work has done much to increase our knowledge of the Thysanoptera of tropical America.

The holotypes, allotypes, and a portion of the paratypes will remain in the collection of the author.

Sericothrips williamsi sp. nov.

Female (*macropterous*).—Length about 1.0 mm. Color yellow, paler by reflected light, with head, fore coxæ, metascutum, and a narrow basal band (wider laterally) on tergites 2-6 of abdomen, brown; pronotal blotch conspicuous by reflected light, invisible by transmitted light, lateral margins straight and parallel, anterior margin roundly, and posterior margin subangulately, concave; antennæ with segment 1 white; 2 and 3 gray, the latter darkened just beyond pedicel; 4-8 dark blackish brown, 4 and 5 with a light spot near base; legs yellow, with mid and hind femora brown at apex and mid tibiæ brown at base; fore wings grayish brown shading to nearly white in apical portion and pale also just beyond scale, darkest in scale and just beyond the subbasal pale band. Mouth cone long and slender, decidedly surpassing base of prosternum, heavily chitinized, labrum nearly black apically. Antennæ noticeably long and

[1]Contributions from the Entomological Laboratories of Cornell University.

conspicuously slender, segment 3 about 3.5, and 4 nearly four, times as long as wide, 8 hardly four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	36	67	60	51	54	11	15
Width (μ)	27	26	19	16	15	15	6	4

Total length of antenna 0.32 mm.

Described from one female taken by Mr. C. B. Williams March 9, 1915, on the island of St. Croix, then Dutch, now American, West Indies. It was found in sweepings from grass.

Aside from the differences in coloration, which are conspicuous, this species may be known from *tricinctus*, undoubtedly its closest relative, by the very much longer and more acute mouth cone.

Sericothrips tricinctus sp. nov.

Female (*macropterous*).—Length about 1.0 mm. Color pale yellow, with ocellar area, anterior half of pterothorax, and abdominal segments 2, 3, and 7 abruptly dark blackish brown; segment 8 of abdomen pale brown; pronotum without trace of dark blotch; antennæ with segments 1-3 nearly white, 3 grayish apically; 4-8 dark gray, with pedicel of 4 pale; legs pale yellow, hind femora and usually mid femora lightly brown at apex; fore wings brown at extreme base and in scale, nearly white in remainder of basal fourth, dark gray beyond, fading to white at tip. Mouth cone moderate in length, hardly attaining base of prosternum. Antennæ very long and slender, segment 3 about 3.5 times as long as wide, and 8 more than four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	36	60	58	50	59	14	17
Width (μ)	28	28	17	17	16	16	6	4

Total length of antenna 0.32 mm.

Described from several females collected by C. B. Williams in Martinique (type locality), Dominica, Guadeloupe, and Trini-

dad. All except one, which was found in a flower of *Hydrangea*, were taken by sweeping grass.

The long, slender antennæ and the coloration make this a very distinct species.

Sericothrips inversus sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color by transmitted light nearly uniform yellow, with a few brown spots on prothorax two on the metascutum, and one on each side of abdominal tergites 2-7, behind a narrow, transverse, subbasal brown line; antennæ gray in segments 1-3, the first palest, 2 and 3 lightly darkened at sides; 4-8 abruptly dark blackish brown, excepting distal constriction of 4, which is conspicously pale; legs pale grayish yellow, sometines lightly washed with brown; fore wings gray, darker in scale and shortly beyond it, paler at tip. By reflected light, the color is nearly white, with a large gray pronotal blotch (which has a concave anterior margin and is darkest at anterior angles), two gray spots on metascutum, and the bases of abdominal tergites each with a narrow transverse gray band. Mouth cone very long and acute, attaining base of prosternum. Antennæ long and slender; segment 3 about three times as long as wide, 4 decidedly narrowed in distal third, urn-shaped, 8 unusually slender, more than four times as long as wide.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	42	62	52	48	54	14	19
Width (μ)	27	26	19	19	16	16	6	4

Total length of antenna 0.32 mm.

Described from several females taken by Mr. C. B. Williams in Dominica and Trinidad, by sweeping grass.

The coloration of the antennæ—abruptly dark brown in segments 4-8, save for the pale gray *apex* of segment 4, which is decidedly narrowed—should serve for its recognition. The second segment of the antenna is longer than usual in this portion of the genus, and segment 8 is especially long and slender.

Hercothrips gen. nov.

(ἕρκος, a net; θρίψ, a wood worm.)

Body reticulate, at least in head and thorax, abdomen frequently striate. Head always broader than long, with vertex elevated between eyes but not produced to overhang insertion of antennæ. Eyes usually distinctly protruding, pilose. Ocelli approximate, borne on the elevated vertex. Antennæ eight-segmented, with segment 1 small, 2 much longer and broader, 3 and 4 stem-like at either end and with forked trichomes, 6-8 closely united, 8 long and slender. Maxillary palpi two-segmented. Prothorax strongly transverse, shorter than head, without strong bristles, notum foveate. Hind coxæ approximate, separated by a fraction only of their transverse width. Wings slender, not conspicuously broadened at base nor much narrowed beyond it, with two longitudinal veins frequently united with ambient vein; costal bristles and costal fringe distinct, subequal in length. Abdomen not sharply constricted basally; tenth segment rarely divided above.

Genotype: *Heliothrips striatus* Hood.

The following species are known to belong here: *aulmanni* (Karny), *bicinctus* (Bagnall), *brunneipennis* (Bagnall), *cinctipennis* (Hood), *fasciapennis* (Hinds), *fasciatus* (Pergande), *femoralis* (Reuter), *indicus* (Bagnall), *marginipennis* (Hood), *minutissimus* (Bagnall), *pattersoni* (Bagnall), *phaseoli* (Hood), *punctipennis* (Hood), *sculptilis* (Hood), *striatopterus* (Kobus), and *striatus* (Hood), in addition to the five new species described in this paper.

It will be noted that *Hercothrips* comprises essentially those species which we used to place in *Heliothrips*, minus the genotype *hæmorrhoidalis*. In *Heliothrips* as now restricted, is found a somewhat different type of wing, lacking as it does the costal fringe of bristles and having the anterior vein separate from the ambient vein through most of its length, as well as being decidedly broadened basally. In *Heliothrips*, too, the third and fourth antennal segments are differently formed and lack the forked trichomes of *Hercothrips*, while the metascutum is more differentiated, with an elevated triangular central area which

overhangs laterally and posteriorly and serves in this way to hold the wings more firmly in position. Most important of all, however, is the closely approximate condition of the hind coxæ of *Hercothrips*—a type of structure which I have learned to associate with the jumping habit, but with what degree of accuracy I am not sure.

Selenothrips is perhaps the closest relative of *Hercothrips*; but in it is found a fore wing with conspicuous, enlarged bristles on the costal margin and on the two longitudinal veins, many of them much longer than the width of the wing; a pronotum which instead of being reticulate is transversely striate; and an abdomen in which the distal segments are shortened.

Hercothrips insularis sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color nearly blackish brown, *head and thorax not noticeably paler*; coxæ brown; fore and mid femora yellow, shaded with brown at middle, hind femora yellow at base and blackish brown beyond; tibiæ yellow at either end, brown between, hind pair darkest; tarsi lemon yellow; fore wings *brown at base* (excepting costal margin and end of scale), *with a narrow nearly white band just before the fork in the principal vein, nearly uniform brown beyond, very slightly paler toward tip of wing, ambient vein in distal eighth of wing and all veins in third eighth, dark blackish brown*; antennæ with segments 1, 2, and 6-8 blackish brown, 1 paler; 3-5 pale yellowish, indistinctly darkened apically. Head broadest across eyes, 1.25 times as wide as long, cheeks nearly straight, curving slightly to eyes and to base; dorsal surface reticulate (though not deeply) with faint indication of occipital line, roughened within the reticules; frontal costa nearly as wide as first antennal segment. *Eyes about* 0.6 *as wide as their interval*, of normal structure. Ocelli of normal form and position. Antennæ normal, segments formed almost exactly as in *phaseoli*.[2] Prothorax with reticulation much like that of head. Metascutellum distinctly reticulate except at sides. Fore wings with bristles and veins as

[2]See Psyche, Vol. XIX, Pl. 8, fig. b; 1912.

in *phaseoli*.[3] Abdomen reticulate, not striate, strongly roughened within the reticules; segment 10 divided dorsally to near base.

Measurements of holotype (♀): Length 1.13 mm.; head, length 0.118 mm., greatest width (across eyes) 0.148 mm., least width (at posterior angles of eyes) 0.136 mm.; eyes, length 0.068 mm., width 0.040 mm., interval 0.068 mm.; prothorax, median length of pronotum 0.108 mm., width 0.195 mm.; pterothorax, width 0.230 mm.; fore wings, length 0.780 mm., width at middle 0.042 mm., width near base 0.068 mm.; abdomen, greatest width 0.269 mm.; segment 8, length to fringe 0.078 mm., segment 9, length 0.114 mm., segment 10, median length 0.056 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	40	46	40	33	27	15	31
Width (μ)	24	28	21	21	20	17	7	5

Total length of antenna 0.25 mm.

Described from a number of females collected in St. Croix (type locality), Grenada, Tobago, Martinique, Trinidad, Porto Rico, and Cuba, by C. B. Williams, F. W. Urich, T. H. Jones, and S. C. Bruner. Most of the specimens were taken by sweeping, though the Cuban and Porto Rican ones came from corn, sugar cane, and possibly from molojillo.

This is a member of the group which includes *fasciatus*. The long head will distinguish it from that species, while the italicized characters will serve for its separation from *cinctipennis*, to which it is more closely allied.

Hercothrips nanus sp. nov.

Female (*macropterous*).—Length about 0.84 mm. Head and thorax brownish yellow, the head darkened with brown in posterior half and with a narrow, nearly black line along posterior margin, the thorax darkened with brown along sides and in anterior portion of mesothorax, *dorsum of metathorax very pale*; abdomen with segment 1 concolorous with dorsum of metathorax, 2-8 dark brown, and 9 and 10 pale brown; antennæ with segments

[3]L. c., Pl. 8, fig. a.

1 and 2 gray or very pale brown, 3-5 pale gray with apices (particularly of 3 and 4) darker, and 6-8 dark gray-brown; femora pale brown, mid and hind pairs with their apical thirds nearly colorless; tibiæ pale yellowish, with a brown band at middle; tarsi pale yellow; fore wings clear white in basal third, dark gray brown in middle third, and white in apical third save the tip, which is dark gray brown. Head about 1.5 times as wide as long; cheeks nearly straight, rounded to eyes and slightly converging posteriorly; dorsal surface distinctly but not conspicuously reticulate, roughened between the lines of reticulation; *frontal costa broad, 1.2 times as wide as first antennal segment, the interval between antennæ fully* 1.3 *times the width of first antennal segment*; vertex subcarinate in front of ocelli. Eyes not prominently protruding, pilose. Ocelli approximate, opposite center of eyes. *Antennæ about* 2.1 *times as long as head*, formed almost exactly as in *phaseoli*,[4] but slightly stouter. *Prothorax more than twice as wide as long, shorter than head* and with similar reticulation. Wings of fore pair 13 times as long as width at middle, venation as usual; *principal vein at base with five bristles, the first three of which are slender and white, the other two stout, approximate, nearly black, and situated at the fork*; anterior vein with two bristles near apex, the latter one nearly black; *posterior vein with four equidistant bristles at middle, the second and fourth ones nearly black and situated, respectively, near the outer margin of the dark band and at the middle of the white band.* Abdomen with tergites 2-8 closely striate laterally, the striæ transverse toward middle of segments and longitudinal at sides, almost exactly as in *phaseoli*;[5] tergite 10 without longitudinal dorsal suture, though irregularly weakened toward tip.

Measurements of holotype (♀): Length 0.84 mm.; head, length 0.102 mm., greatest width (behind eyes) 0.157 mm., least width (across eyes) 0.151 mm.; interval between antennæ 0.031 mm.; eyes, length 0.065 mm., width 0.038 mm., interval 0.075 mm.; prothorax, median length of pronotum 0.081 mm., width 0.176 mm.; pterothorax, width 0.228 mm.; fore wings, length

[4]See Psyche Vol. XIX, Pl. 8, fig. b; 1912.
[5]L. c., fig. c.

0.585 mm., width at middle 0.045 mm., near base 0.061 mm.; abdomen, width 0.236 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	17	34	43	37	30	23	10	23
Width (μ)	23	28	21	21	18	16	7	4

Total length of antenna 0.22 mm.

Described from 18 females from Trinidad and Tobago, British West Indies, taken by F. W. Urich and C. B. Williams, respectively, principally on a wild vine belonging to the genus *Couania*.

Very close to *phaseoli*, but the smaller size and the italicized characters will separate them readily.

Hercothrips masculinus sp. nov.

Female (*macropterous*).—Length about 1 mm. Color uniform gray brown, ocellar pigment dull orange yellow by transmitted light, lemon yellow by reflected light; antennæ largely brown and nearly concolorous with body, segment 1 paler, 2 dark blackish brown; 3 with stem white, globose portion and apex gray brown; 4 with brief pedicel nearly white, remainder dark blackish brown, but paler basally; 5 clear white except for a slight brownish cloud at extreme apex; 6-8 dark blackish brown; legs largely brown, knees, tarsi, and most of fore tibiæ pale yellow; *fore wings dark gray brown, with a narrow white band just beyond scale and another in eighth tenth, a few darker streaks at base* and a small slightly elevated dark spot on the costal margin just beyond the pale subbasal band, this spot darker because covered with longer and heavier pubescence than the rest of wing, all veins darker, especially the ambient vein at tip of wing, scale paler. Dorsal surface of head and thorax, lateral thirds of abdominal tergites 1-8, and a narrow median portion of tergites 1 and 2, with dark polygonal reticulation, surface roughened within the reticles. Head broad, without occipital line or neck-like constriction, cheeks nearly straight but somewhat converging posteriorly, rectangularly narrowed to eyes; ocellar area opposite center of eyes, slightly elevated but not produced no

overhanging. Antennæ separated by somewhat more than the width of segment 1; segments 3 and 4 much as in *phaseoli*[6] but more globose and with the pedicel of 4 more abrupt and shorter; 5 slightly slenderer; 8 longer and slenderer; 3 and 4 with forked trichomes. Wings of fore pair with about 18 short, inconspicuous bristles on costal margin, *those in basal portion of wing half as long as distal ones and less than half the width of wing, fringe about as long as distal bristles;* anterior vein with one near fork and one near tip, very inconspicuous and pale; posterior vein with about five similar bristles. Abdomen with *segment 9 long, 2.5 times the length of 10 and about 1.2 times as wide at base as long, width at apex (across bases of lateral bristles) about 0.66 that at base,* its inner pair of dorsal bristles shorter than outer, which are slightly longer than segment 10, both pairs approximate and *disposed in a straight transverse line.*

Measurements of holotype (♀): Length 1.05 mm.; head, length 0.118 mm., greatest width (behind eyes) 0.174 mm., least width (at base) 0.160 mm.; eyes, length 0.072 mm., width 0.044 mm., interval 0.080 mm.; prothorax, median length of pronotum 0.104 mm., width 0.212 mm.; pterothorax, width 0.255 mm.; fore wings, length 0.735 mm., width at middle 0.044 mm., near base 0.057 mm.; abdomen, width 0.261 mm.; segment 8, length to fringe 0.078 mm.; segment 9, length 0.128 mm., width at base 0.156 mm., width across bases of lateral bristles at apex 0.104 mm.; segment 10, length 0.050 mm., width at base 0.082 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)			43	38	35	22	8	25
Width (μ)	23	30	22	21	18	17	9	5

Total length of antenna (approximate only) 0.23 mm.

Described from a unique female taken from bamboo at St. Annes, Trinidad, in the British West Indies, March 28, 1915, by C. B. Williams [C. B. W. No. 612].

The elongate and only slightly tapering ninth abdominal segment seems to be unique in the genus, occurring in none of

[6]See Psyche, vol. XIX, Pl. 8, fig. b; 1912.

the other fourteen species before me, and aids in giving the female a most decidedly male-like appearance when seen under a low-power objective. Other important differentiæ are those italicized above.

Hercothrips williamsi sp. nov.

Female (*macropterous*).—Length about 1.05 mm. Color dark brown (nearly black to the naked eye), darkest in abdominal segments 5 and 6, *head yellow between eyes, save for the ocellar area and a narrow brown line from it to the frontal costa*; antennæ with segment 1 brownish yellow; *distal constriction of 3, pedicel and distal constriction of 4, and all of 5 clear white, the intervening portions dark blackish brown*; legs blackish brown, the mid and hind pairs darkest; tarsi and tips of tibiæ yellow; fore wings dark brown, paler between veins and in a narrow transverse band just beyond scale, with a darker streak at base in front of longitudinal vein and a *small, round, slightly elevated dark spot on the costal margin just beyond the pale subbasal band, this spot darker because covered with longer and heavier pubescence* than the rest of the wing. Dorsal surface of head, thorax, and median portions of abdominal tergites 1 and 2 with conspicuous subequal polygonal reticulation, formed by raised *black* chitinous lines, not roughened between the lines of reticulation. Head broad, with a *prominent lateral swelling at anterior end of cheeks*, sides abruptly converging posteriorly to a transverse groove on each side which shallows dorsally and disappears before attaining the median line; ocellar area opposite center of eyes, slightly elevated but not at all produced nor overhanging, with a narrowly grooved ridge running from it downward to frontal costa. *Antennæ separated by 1.8 times width of segment 1*; segments 3 and 4 with a subglobose middle portion, pedicels slender, *distal portions slender and much prolonged*; forked trichomes on 3 and 4 exceptionally long. Wings of fore pair with about 20 dark bristles on costal margin, averaging fully as long as width of wing and subequal in length to fringe; anterior vein with one similar bristle near fork and 3 in distal fourth of wing; posterior vein with about 8 equally spaced bristles; about four bristles on vein

basal to fork. Abdomen with last segment short and broad; *tergites 2-7 striate, rather than reticulate, at sides*, the lines curving outward and backward; bristles not long, yellowish and inconspicuous.

Measurements of holotype (♀): Length 1.05 mm.; head, length 0.140 mm., greatest width (behind eyes) 0.196 mm., least width (across eyes) 0.184 mm.; eyes, length 0.082 mm., interval 0.096 mm.; prothorax, median length of pronotum 0.102 mm., width 0.220 mm.; pterothorax, width 0.293 mm.; fore wings, length 0.810 mm., width at middle 0.044 mm.; abdomen, width 0.318 mm.; segment 9, length 0.116 mm.; segment 10, length 0.049 mm., width at base 0.080 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	48	73	58	40	34	16	30
Width (μ)	26	32	24	23	17	16	8	5

Total length of antenna 0.32 mm.

Described from a unique female taken at St. Annes, Trinidad, in the British West Indies, March 28, 1915 by C. B. Williams, from an unidentified plant. [C. B. W., No. 614.]

A very distinct and most interesting species, resembling *brunneipennis* in wing coloration but related more intimately to *striatus*, *phaseoli*, and their allies. The sculpture, large head, anteriorly tubercled cheeks, and peculiarly colored antennæ are distinctive.

Hercothrips funebris sp. nov.

Female (*macropterous*).—Length about 1.1 mm. Color nearly black (quite so in abdomen), head and thorax paler; antennæ brown, with segments 1 and 2 paler, and the basal half of 3, basal third of 4, and basal two-thirds of 5, grayish white; fore legs brown, with trochanters, tips of tibiæ, and tarsi pale yellow, nearly white; mid and hind legs similarly colored, but with the dark portions nearly black; fore wings nearly uniform dark brown, with a pale transverse band just beyond scale, with a dark streak at base in front of principal vein and another behind it, and with the costal half of wing just beyond the pale band and the extreme tip, nearly black. Dorsal surface of head,

thorax, and abdomen strongly and prominently reticulate with heavy black lines, not roughened between the lines of reticulation, except for a few dots in basal reticules of head. Head broad, cheeks rounded and swollen, with a strong neck-like constriction which is bounded in front by a heavy chitinous line. Antennæ separated by about 1.7 times the width of segment 1, formed almost as in *phaseoli*,[7] forked trichomes on 3 and 4 exceptionally long, that on 4 attaining apex of segment 5. Metascutum without differentiated triangle; metascutellum strongly reticulate. Wings of fore pair with about 22 inconspicuous brown bristles on costal margin, averaging in length less than the width of wing, fringe fully twice as long; anterior vein usually with one similar bristle at the fork and four in distal half; posterior vein with about eight and principal vein with six. Abdomen of normal form, opaque black, reticulation coarse and heavy, not absent from middle portions of tergites but extending entirely across them and strongest just beyond the irregular, subbasal, transverse line; segment 10 with an irregular dorsal suture in apical half; all abdominal bristles pale and short.

Measurements of holotype (♀): Length 1.08 mm., head, length 0.105 mm., greatest width (behind eyes) 0.176 mm., least width (near base) 0.135 mm.; eyes, length 0.085 mm., width 0.045 mm., interval 0.087 mm.; prothorax, length 0.102 mm., width 0.201 mm.; pterothorax, width 0.267 mm.; fore wings, length 0.780 mm., width at middle 0.041 mm., near base 0.067 mm.; abdomen, width 0.300 mm., segment 8, length to fringe 0.076 mm.; segment 9, length 0.087 mm.; segment 10, length along median dorsal line 0.036 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	41	59	49	36	28	12	25
Width (μ)	24	30	22	23	20	17	8	5

Total length of antenna 0.27 mm.

Male (*macropterous*).—Length 0.87 mm. Color of body and appendages like that of female. Tergite 9 with the two pairs of bristles slender, the inner pair shorter, slenderer, and with their bases more distal, the four thus being disposed on a semicircle.

[7]See Psyche, vol. XIX, Pl. 8, fig. b; 1912.

Described from one female and one male, taken by J. B. Rorer at Hacienda Pretoria, near Barraganetal, Equador, December 29, 1917, on "cojojo" [C. B. Williams, No. 1058.]

Close to *errans* and *brunneipennis*, but differing from both in the non-specialization of the metascutum, the clouded antennæ, the incompletely divided tenth abdominal segment, and various other details.

Tryphactothrips lineatus sp. nov.

Female (*macropterous*.—Length about 1.05 mm. Dorsal surface deeply reticulate. Color yellowish brown, with head, prothorax, middle of pterothorax, and last two or three abdominal segments more yellowish; segment 10 of abdomen gray in apical sixth; antennæ yellow, with segment 2 decidedly darker than 1 and brownish at sides and base, 3-5 clear lemon yellow, 6-8 blackish brown excepting yellowish base of 6; fore legs yellow with tibiæ shaded with blackish brown on inner surface, mid and hind legs brown with tarsi, knees, and bases of femora yellow; fore wings yellowish at base and along veins, with two indistinct brown bands, one occupying the third tenth, the other the seventh tenth, and with two or three very faint maculations between the bands and one at extreme tip of wing, all of these wing markings produced by darker pubescence; wing bristles nearly black in basal half, nearly white beyond. Vertex produced, overhanging insertion of antennæ; occiput without a crescentic series of large reticulations; *antennæ eight-segmented*; segment 1 short, subcylindrical, about as broad as long; 2 broadest in entire antenna; 3 slender, vasiform, about 4.3 times as long as wide; 4 asymmetrical, swollen on outer surface; 5 clavate, broadest at apical fourth or fifth; 6 with a stout pedicel which is nearly twice as thick as that of 5, somewhat obliquely united at apex to 7, the two forming a compact mass; 8 slender, about six times as long as basal width; sense cones slender, those on 3 and 4 bifurcate beyond base (Y-shaped). Mesoscutum without median suture, but acutely notched behind. Wings of fore pair with first longitudinal vein united with ambient vein, posterior vein not so united, one bristle at their fork and three basally; anterior vein

with six bristles beyond fork and posterior vein with seven or eight, positions not constant; all wing bristles long, broad, flattened, and dilated, as long as width of wing at middle. Abdomen strongly and sharply constricted at base of segment 2, which is the longest in the entire abdomen; dorsal surface with the usual deep, prominent reticulation at sides, but with the *dorsal surface of segments 3-7 with three or four perfectly parallel transverse lines* at base, between the areas of reticulation; segment 10 long, tubular, reticulate, somewhat constricted at base, divided above by a longitudinal suture; bristles at apex of segment 9 about one-half as long as 10.

Measurements of holotype (♀) Length 1.05 mm.; head, length 0.100 mm., greatest width (across eyes) 0.172 mm., least width (near base) 0.152 mm.; eyes, length (approximate) 0.092 mm., width (approximate) 0.040 mm.; prothorax, median length of pronotum 0.090 mm., width 0.180 mm.; pterothorax, width 0.248 mm.; fore wings, length 0.780 mm., width at middle 0.046 mm., just beyond scale 0.076 mm.; abdomen, width 0.285 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	34	65	42	36	25	12	30
Width (μ)	24	30	15	17	18	17	11	5

Total length of antenna 0.26 mm.

Trinidad; C. B. Williams; on an unidentified plant.

This is the only New World species with eight-segmented antennæ. The curious transverse lineation of the abdomen is also distinctive.

Tryphactothrips brevipilus sp. nov.

Female (*macropterous*).—Length about 1.04 mm. Dorsal surface deeply reticulate. Color yellowish brown, with middle of pterothorax and last three or four abdominal segments paler and more yellowish; segment 10 of abdomen shading to *gray in apical fourth*; antennæ yellow, with segment 2 decidedly darker than 1 and brownish at sides and base, 3-5 pale lemon yellow except apex of 5 which is washed with gray, 6 yellowish gray;

femora yellowish brown, paler at base and sometimes at apex, middle pair lightest; tibiæ yellow at base and apex, brown between; tarsi lemon yellow; fore wings brown in first tenth (except the yellowish costal margin and the paler outer half of scale) and with brown bands (due to dark pubescence) occupying most of the third tenth, all of eighth tenth, and the extreme tip of wing, between the bands with three or four faint maculations, the veins somewhat darkened with brown; bristles on veins of wings unicolorous, brown. Vertex strongly produced, about attaining second segment of antenna, overhanging. Antennæ six-segmented, segment 5 with a more or less distinct transverse suture at distal third; segment 1 short, subcylindrical, about as broad as long; 2 broadest in entire antenna; 3 slender, vasiform, about 4.6 times as long as wide; 4 asymmetrical, swollen on outer surface, with a rather long and slender pedicel; 5 subfusiform, pedicellate; 6 long and very slender; sense cones slender, those on 3 and 4 bifurcate beyond base (Y-shaped). Mesoscutum with a longitudinal, median suture extending nearly to anterior margin, *the reticles on either side with their inner margins not at all deflected posteriorly*. Wings of fore pair with first longitudinal vein united with ambient vein, posterior vein free, one bristle at their fork and three basally; anterior vein and costa together with about eleven bristles beyond fork, the two series indistinguishable; posterior vein usually with six bristles beyond fork; *all wing bristles short, stout, but not dilated, averaging about one-half as long as width of wing at middle.* Abdomen strongly and sharply constricted at base of segment 2, which is the longest in the entire abdomen; dorsal surface with the usual deep, prominent reticulation at sides, the intervening portion with transversely elongate polygons of reticulation arranged in regular transverse rows; segment 10 nearly tubular, about three-fourths as long as prothorax, *not constricted at base*, reticulate, divided above by a longitudinal suture; *bristles at apex of segment 9 about one-third as long as 10.*

Measurements of holotype (♀): Length 1.04 mm.; head, length 0.116 mm., greatest width 0.190 mm.; eyes, length 0.056 mm., width 0.042 mm., interval 0.101 mm.; prothorax, length 0.106 mm., width 0.183 mm.; pterothorax, width 0.266 mm.;

fore wings, length 0.720 mm., width at middle 0.041 mm., near base 0.076 mm.; average length of bristles near middle of wing 0.020 mm.; abdomen, greatest width 0.293 mm.

Antennal segments:	1	2	3	4	5	6
Length (μ)	24	40	73	43	59	28
Width (μ)	26	31	16	19	20	5

Total length of antenna 0.27 mm.

Trinidad: C. B. Williams; on creepers, bushes, and a leaf of Arum Lily.

The characters italicized in the description separate it from *constrictus*, the only New World species with which it agrees in the possession of six-segmented antennæ and a divided mesoscutum.

Eurythrips cinctus sp. nov.

Female, forma macroptera.—Length about 1.16 mm. Color yellowish brown, *with transparent red subhypodermal pigmentation*, sides of head and all of thorax and apical abdominal segments darker, the *base of abdomen* (*especially segments 2 and 3*) *decidedly paler* and almost free of red pigmentation, giving the insect a distinct yellowish band at middle; *antennæ nearly uniform blackish brown*, somewhat paler in basal portion of segment 1, apical portion of 2, and pedicel of 3; femora brown, shading to lemon yellow beyond middle of tibiæ; fore wings pale brown, decidedly darker at base. Head nearly 1.2 times as long as greatest width; *ocelli rather widely separated, nearly touching margins of eyes, the interval between posterioro celli about 0.54 that between eyes*; postocular bristles about 0.4 as long as head, pointed or very nearly so; postocellar bristles very minute, about attaining posterior margins of posterior ocelli; mouth cone broadly rounded, somewhat surpassing middle of prosternum; prothorax with anterior marginal bristles minute, all others long, pale, and very nearly pointed; fore tarsus with a small, claw-like, somewhat forwardly-directed tooth arising from the inner distal angle of the first tarsal segment; fore wings without accessory hairs at tip and with the three subbasal bristles short, slightly dilated apically.

Measurements of holotype (♀): Length 1.16 mm.; head, length 0.165 mm., greatest width 0.139 mm., least width (across eyes) 0.131 mm.; eyes, length 0.046 mm., width 0.035 mm., interval 0.061 mm.; postocular bristles, length 0.068 mm.; prothorax, length of pronotum 0.120 mm., width across coxæ 0.240 mm.; pterothorax, width 0.248 mm.; abdomen, greatest width 0.300 mm.; tube, length 0.124 mm., width at base 0.071 mm., at apex 0.035 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	40	48	51	48	50	46	44	34
Width (μ)	38	32	32	31	30	26	25	16

Total length of antenna 0.36 mm.

Female, forma brachyptera.—Apparently identical with the macropterous form except for the following: Legs much paler, the tibiæ, tarsi, and distal portions of femora lemon yellow; ocelli wanting; wings reduced, the fore pair represented by a pair of small oval brown pads, each with two rather long, nearly pointed bristles.

Described from three females taken by Mr. C. B. Williams at Caura Valley, Trinidad, British West Indies, April 20, 1916, by sweeping grass.

Very close indeed to *E. harti*, but readily known by the italacized characters.

Book Notices.

Needham, J. G. & Needham, P. R.

A guide to the Study of Fresh-water Biology. 88 pp. American Viewpoint Soc. New York & Albany, N. Y.

This is a very practical compendium of the fauna and lower plant organisms of fresh-water ponds and streams. As might be expected, the major portion of the text relates to insects, but the several other groups are covered equally well. There are an enormous number of good line drawings, and these, together with dichotomic keys for the determination of the organisms, occupy the bulk of the book.

Aside from its value to young students of biology, it should be very useful to the more mature biologist who disdains the intricacies of taxonomy.

C. T. B.

Garman, Philip

The Odonata or Dragonflies of Connecticut. Bulletin 39, State Geological & Natural History Survey of Connecticut. 1927.

The present volume of 331 pages, illustrated by 67 figures and 22 plates, is the latest addition to the "Insects of Connecticut." Many of the figures contain ten or more well executed line drawings and leave little to be desired in the way of illustration. In addition to keys and descriptive matter in the text, pertaining to the imaginal dragonflies, the nymphs are dealt with in great detail. All in all, this compendium will be a great boon to entomologists in New England.

C. T. B.

Buxton, P. A. & Hopkins, G. H. E.

Researches in Polynesia & Melanesia. Mem. Series No. 1, London School of Tropical Medicine, 260 pp. London 1927.

This is a very beautifully prepared account of the bionomics of *Aedes variegatus* and *A. argenteus* and contains much other material of interest to medical entomologists.

Of particular interest to general biologists is a chapter on the "Climate of Samoa," which discusses temperature and humidity in relation to the biological environment, together with some very sane observations on the use of physical instruments for recording such data.

C. T B.

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